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A STUDY OF A PORTION OF THE IOWAN DRIFT BORDER IN FAYETTE COUNTY, IOWA.

BY GRANT E. FINCH.

When a boy, living on the border between the Iowan and the Loess-Kansan drift sheets, the great difference between the two regions was very apparent to me then, and now, in the light of the extensive and interesting contributions to glacial geology in recent years, it is a pleasure to take a geological review of the scenes of my boyhood. It is my purpose to make a few observations relating to the Iowan drift border in Fayette county, Iowa, in particular the region between West Union and Fayette.

The first and most apparent feature to the eye is the great and abrupt contrast in topography; the Iowan prairies, gently undulating, with broad and basin-like valleys, and abounding in boulder-bearing sloughs; the rolling Loess-Kansas region, a timber country so far as not yet cleared, with sharply-rounded hills, deep and often narrow valleys, and almost without sloughs or boulders. Leaving West Union by the east wagon road to Fayette, which crosses the railroad tracks just east of the round houses of the railroad companies, one can locate to the east the Iowan drift border all along the way, almost without leaving the main road. The Loess-Kansan hills rise abruptly and with little transition interval to separate them from regions of typical Iowan in topography, and can be easily seen and recognized a mile or more away. Were we to stand on the edge of the Loess-Kansan hills and look out across the Iowan drift the change would be no less conspicious.

One of the very apparent features of the Iowan drift, as its edge is approached, is its sandy character. The wagon road just mentioned between West Union and Fayette is so sandy as to be poorly adapted for travel, especially to the cyclist or automobilist. This sandy zone is evidence of an outwash from the melting front of the Iowan ice. The farms of this region have a soil that is warm and quick but rather light. They were the first lands to be settled after the occupation of the river bottoms.

Where this sandy zone comes in contact with the edge of the Loess-Kansan there was no overlapping observed; either of the loess over the Iowan deposits or of the Iowan over the loess, a fact that would go to show simultaneous deposition of the two formations.

Another interesting point for observation here is the undrained portion of the Iowan, known as "sloughs". Any one who has lived in this region and dug post-holes, and plowed, knows that the higher ground contains fewer boulders than the sloughs, which are always plentifully dotted with "nigger-heads", usually lying well up out of the ground. The slough soil is a tough, unassorted till. The up-lands are more sandy

and gravelly, and in many places show some signs of assortment of material approaching stratification. Gravel banks and sand banks, well stratified, are shown at the top of all the higher hills in the drift. The crests of the conical hills are crowned with caps of small boulders and cobble stones, so thick-set as to make cultivation impossible. Such hills are well shown at the southeast corner of the Fayette County Poor Farm, the cemetery being located on the top of the highest one. These facts seem to establish a kame—or esker—like nature of the hills and ridges of the Iowan border. It is probable that the present elevations in the drift surface mark the positions of depressions in an ice sheet of irregular surface as it began to melt. The lowest points of these depressions received the materials from the melting slopes. All materials were washed along except the largest boulders, and somewhat assorted by water. Steep kettle-hole depressions in the ice account for the formation of the conical hills, with their caps of cobble stones. Long, gravelly ridges mark the position of longer depressions with more gentle slopes. When the melting had progressed so far that the divides between the depressions in the ice had sunk as low or lower than the original depressions, the remaining fragments of the ice sheets slowly melted in place, depositing the remainder of their detritus without washing or assortment, and the accumulated boulders of the earlier stages of melting were left lying on the surface of this till.

Perhaps the most interesting point to the observer in this region is the three phases exhibited in the valley of each stream that begins in the Iowan drift and flows outward across the border into the Loess-Kansan.

The first phase, that in the Iowan, is a valley broad and shallow, often nearly as wide as long. The contour exhibits no sharp lines. The low, convex divides, with gentle undulations, separate the streams, which course gently through broadly concave sloughs in which they have done very little work since the close of the Iowan ice period.

The second phase of each valley begins where the wide slough bottom narrows down to a point from which the stream flows through a small V-shaped gorge trenched into limestone. This stage of each valley is narrow with rather steep, but smooth and rounded, sides of limestone which stand out clean and unweathered. The narrow floor of each valley is in places covered with a thin layer of till, as is well shown just above the county bridge four and one-half miles south of West Union. Also along the line of the Chicago, Milwaukee & St. Paul Railroad, just above where it intersects an unfinished railway grade two and a half miles east of Randalia, the drift for a distance of a half mile has almost obliterated the valley of the stream. But even here low hills of limestone are exposed to the east of the stream. In general these valleys are sharply defined and little affected by drift deposits. A broad belt of sandy soil, flanking at either side this stage of the valleys, is a constant feature. It stretches outward from the top of the inner valley for a distance of a fourth to a half mile or more.

On the hill-tops along the middle stage of the streams we occasionally find places where the sandy borders give place to bare, flat-topped stretches where the bed-rock lies everywhere practically at the surface. An example of this may be found to the south of the rock cut of the railroad company at Fayette; another occurs on the hill-tops back of the large spring one-half mile north of Fayette; another, one-half mile to the northeast of the small cemetery on the West Union & Fayette road; and still another, one-half mile to the west of the cemetery at Dunham's Grove, in Center township.

There is no disintegrated limestone at the surface of these miniature plateaus, only the hard level surface scantily covered with soil. Occasionally small boulders may be found but they are by no means abundant. Neither can glacial scorings be found, though the absence of rock waste would seem to be evidence of glacial action. It is unlikely that the Kansan drift sheet could have planed off such surfaces, because we could not suppose that the fresh, unweathered Devonian limestone dated back to the same time as the highly oxidized and even decayed Kansan drift. We are then left to believe that such action was caused by the Iowan ice sheet, even though Iowan till and boulders are almost entirely absent.

This second phase of the valleys is interesting as indicating that the glacier along its margin was deeply indented by the streams of the region. The length of the notches back into the Iowan drift varies in six good instances, found between West Union and Fayette, from a half mile in the case of the little streams three to four miles north of Fayette to two miles in the case of the Coulee, a stream southeast of Donnan Junction, and at least six miles in the Volga Valley, or from a short distance above Fayette all the way to Maynard. To that extent were the streams able to keep their channels intact in spite of the Iowan ice sheet. The length of the second phase of each valley varies in proportion to the size of the stream.

The third phase of these valleys begins where the sandy border lands give place to the higher and much more uneven Loess-Kansan. The valleys here are much deeper than in the second stage, but this is due more to the loess accumulations on the hill-tops than to deeper trenching of the streams into the limestone. McGee has well described the paradoxical appearance of the streams rising in the low-lying Iowan plains and flowing into the higher loess-mantled region, and this fact is everywhere well shown in this section.

It seems very strange and unaccountable that in the second and third stages of these valleys as above described, there should be no gravel trains or terraces, but such is the fact. The only exception observed is along the Volga from Maynard northward for some two and a half miles. There we find the valley pretty continuously lined with gravel deposits, but from here on for some five miles in a limestone channel through the Iowan drift, down to Fayette in the Loess-Kansan stage of the valley, no gravel trains or terraces were observed. The sandy outwash from the Iowan is so general just at the margin of the Loess-Kansan hills, and

the sandy borders so prevalent in the second stage of the stream valleys, both signifying extensive water action, that we would expect the streams to have been greatly overloaded with detritus, which would then naturally be deposited in extensive terraces and valley trains.*

It would seem plain that the melting of the ice sheet must have been very slow or else the streams would have been greatly swollen in size and have left extensive deposits high up along the sides of their valleys. The outwash plains of sand and the hills and ridges partaking of the nature of kames and eskers, might be formed without a great flow of water at any one time.

The relations of the Iowan and Kansan drift sheets along their contact line are intricate and puzzling. One finds Kansan-like contours of hills and valleys, dotted with Iowan borders, or again on Iowan topography exposures of materials are apparently Kansan in the gravel beds and roadside sections. A considerable section, beginning one mile south of West Union on the east road to Fayette, appears like Kansan in topography, but has no mantle of loess. It might be expected at the Iowan border, where the deposit of that ice sheet thins out, that there would be frequent outcroppings of the Kansan. Where the deposit seems to be a mixture of the Iowan and Kansan, it may be believed that the Kansan deposits were worked over and somewhat intermingled with Iowa drift during the Iowan ice invasion.

*A. G. Wilson, in an article a few years ago, suggested the interesting hypothesis, to account for the preservation of such valleys, that the waters successively overflowing and freezing, gradually filled full with solid ice up to the top of the hills, thus protecting the valleys from glacial action.